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16. ABSTRACT

An acute gastrointestinal illness affected 213 (52%) of 407 campers and 64 (52%) of 121 staff attending a boy's camp in the Catoctin Mountains of Maryland during the summer of 1981. Nausea was the predominant symptom for ill campers and staff (73%), but more staff members experienced diarrhea (49%) than did campers (9%, p 0.001). Eight of nine paired blood specimens from ill staff members showed a 4-fold increase in antibody titer to Norwalk agent by radioimmunoassay. A common source could not be identified for the outbreak. The slope and pattern of the epidemic curve were compatible with a person-to-person spread. It is hypothesized that the outbreak was initiated by the arrival of new campers in the middle of the season and perpetuated by the close personal contact provided by camp life.

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JOURNAL ARTICLE

An Outbreak of Norwalk-Related Gastroenteritis at a Boys' Camp

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• **An acute gastrointestinal tract illness affected 213 (52%) of 407 campers and 64 (53%) of 121 staff members attending a boys' camp in the Catoctin Mountains of Maryland during the summer of 1981. Nausea was the predominant symptom for ill campers and staff members (73%), but more staff members experienced diarrhea (49%) than did campers (9%). Twenty-three individuals had more than one episode of illness compatible with the case definition. Eight of nine paired blood specimens from ill staff members showed a fourfold increase in antibody titer to Norwalk virus by radioimmunoassay. Environmental inspections and laboratory tests failed to implicate a common source of exposure.**

(*AJDC* 1985;139:787-789)

Acute, infectious, nonbacterial gastroenteritis (AING) is a clinical entity that pediatricians frequently encounter. The common cold is the only illness that affects US families more frequently. Identification of the viral agents responsible for AING was delayed because in vitro cultivation has not been successful. However, in the 1970s, through the use of immune electron microscopy, two major virus groups were discovered: the Norwalk-like viruses and the rotaviruses. Norwalk-like viruses cause explosive, self-limiting disease in all age groups. The signs and symptoms may include any combination of vomiting, diarrhea, nausea, abdominal cramps, headache, low-grade fever, anorexia, malaise, and myalgia lasting for 24 to 48 hours. Rotaviruses usually affect infants and children with a severe diarrhea of five to eight days' duration accompanied by fever and vomiting. Other viral agents have been associated with AING, but epidemiologic evidence is lacking that would implicate them as major pathogens. Of the Norwalk-like viruses, the prototype is the Norwalk virus itself because it is the only one for which radioimmunoassays are available.[1] Common sources of Norwalk-like infection that have been documented include drinking water,[2-4] recreational water,[5,6] and food,[7,8] including raw shellfish.[9] Primary person-to-person transmission has been described with much less frequency than secondary spread from a common source.[10] This report deals with a summer camp outbreak of serologically confirmed Norwalk gastroenteritis that involved both campers and staff.

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Presented before the Epidemic Intelligence Service Conference, Centers for Disease Control, Atlanta, April 18, 1983.

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PATIENTS AND METHODS

Background

The outbreak occurred at a private boys' camp in the Catoctin Mountains of Maryland between July 21 and Aug 11, 1981. Approximately 375 boys, ages 6 to 16 years, were in attendance, living in 31 cabins that held 12 to 14 campers each. The majority of campers were in the 10- to 13-year-old age range. A staff of approximately 145 men and women, from 18 to over 60 years of age, managed the day-to-day running of the camp, including administrative, kitchen, and counseling duties. The three meals a day were eaten in a single large dining hall by the entire camp at the same time. Water for the entire camp, including the swimming pool, was supplied by a single well. Water was pumped to a 25,000-gal storage tank located on the hillside above the cabins and gravity fed to the camp. The water was automatically chlorinated before entering the top of the storage tank. Approximately 40,000 gal of water per day were drawn from the bottom of the tank for use in the camp. Sewage was handled by a drainage field situated on the hill below the entire camp and its well. It was chlorinated and then dechlorinated before being discharged into a small stream also situated below the entire camp.

The camp season consisted of four two-week sessions. A 90% turnover of campers occurred at midseason on July 21. During the four weeks following this change, there was an additional 9% turnover of campers. This resulted in a total of 407 campers who were at risk during the last half of the season. The camp was rented by private organizations before and after the regular season. No outbreaks occurred during the first half of the season or while in use by private organizations.

Epidemiologic Investigation

A case was defined as any camper or staff member with one or more of the following: vomiting, diarrhea, nausea or abdominal cramps with onset between July 21 and Aug 12, and who did not have some other definite explanation for their illness. Campers who complained of illness were referred immediately to the infirmary; therefore, review of infirmary records was used to identify cases and onset dates in campers. Since staff use of the infirmary was limited, a combination of self-administered questionnaires and infirmary records was used to obtain information on staff illness. No information was obtained on cooks, dishwashers, or household and security personnel. This resulted in an 83% response rate for the staff.

The camp administrative office supplied information on cabin, unit, dining table,

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and counselor assignments. In addition, activities and social functions were reviewed with the administrators.

Environmental Investigation

Two inspections of the kitchen sanitation were done; one was by a local health department sanitarian and one was by the private company who managed the kitchen and dining room. Results of chlorine level and bacterial analyses of drinking and pool water from the month prior to the outbreak were reviewed; during the outbreak bacterial cultures were obtained on prechlorinated and postchlorinated water, leftover foods, and predischarge treated sewage.

Table 1.—Comparison of Frequency of Symptoms in 213 Campers and 64 Staff Members

Symptom	Campers, %	Staff, %
Nausea	61	73
Vomiting	47	47
Abdominal cramps	45	45
Headache	24	45
Diarrhea	9	55
Fever	3	22

Table 2.—Titers to Norwalk Agent in Ill Staff Members

Staff Member/ Age, yr	Acute-Phase Titer	Convalescent-Phase Titer
A/30	1:200	1:3,200
B/...	<1:50	1:50
C/18	1:50	1:100
D/19	1:100	1:400
E/22	1:50	1:400
F/41	1:400	1:3,200
G/19	<1:50	1:100
H/18	1:400	1:1,600
I/47	1:100	1:1,600

Laboratory Investigation

Rectal swabs obtained from five symptomatic campers were placed in buffered glycerol saline for transport and subsequently cultured for *Salmonella* and *Shigella*. The same five campers had additional swabs placed in Cary-Blair transport media and cultured for *Campylobacter*. Two stool specimens were examined for parasites. Fifteen acute-phase blood samples were collected from symptomatic staff members whose ages ranged from 18 to 47 years. Convalescent-phase samples were obtained from nine of the 15 staff members between three and four weeks after the initial specimens. The University of Massachusetts Medical School, Worcester, tested the serum samples by radioimmunoassay for antibodies to Norwalk agent utilizing previously published criteria.[3] It was not possible to obtain whole frozen stool for immune electron microscopy studies.

RESULTS

Epidemiologic Studies

Between July 21 and Aug 12, 1981, 213 (52%) of 407 campers and 64 (53%) of the 121 staff on whom information was available had illness compatible with the case definition, for an overall attack rate of 52%.

As shown in Table 1, nausea was the most common symptom for both campers and staff. The frequencies of vomiting and abdominal cramps were also similar for both groups. The frequencies of diarrhea, fever, and headache were higher for staff than for campers. The duration of illness was from 24 to 48 hours. Nineteen campers and four staff members had more than one episode of gastrointestinal tract illness, ie, gastrointestinal tract symptoms separated by at least two asymptomatic days. Only the first episode for each individual was used in describing and analyzing the outbreak.

Infirmary records for the four weeks prior to July 21 showed that an average of two campers per week were admitted with gastrointestinal tract symptoms. A plot of the number of cases by date of onset (Figs 1 and 2) showed a dramatic increase after July 24 to a peak on Aug 4 and a rapid decline during the following week.

Camper attack rates by cabin ranged from 24% to 87%. There was no association of high attack rates with the cabin location, age of campers, activity schedule, or number of campers per cabin. Seating in the dining room was by cabin, and table attack rates disclosed no particular clustering. The swimming pool was not a likely source for the illness because inclement weather precluded its use before and during the outbreak.

Environmental Studies

The sanitary inspections of conditions in the kitchen and dining room disclosed minor problems with fly control and the length of time tableware was left out, but no obvious source for the outbreak. Samples of drinking and pool water obtained during July and August had adequate levels of chlorine and no signs of fecal contamination. A

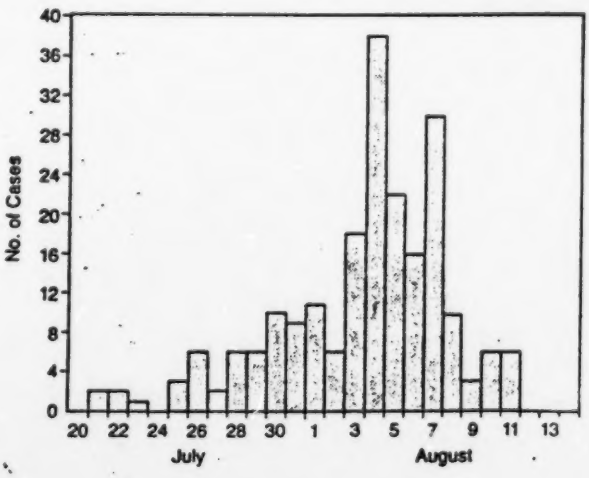
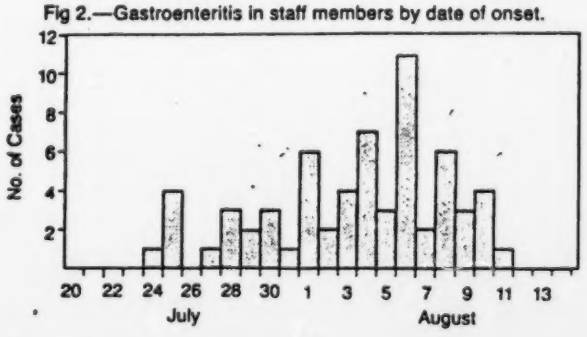


Fig 1.—Gastroenteritis in campers by date of onset.

Fig 2.—Gastroenteritis in staff members by date of onset.



prechlorinated sample taken directly from the well during the outbreak contained no fecal contaminants. Post-treatment sewage contained no fecal coliform bacteria. Leftover corned beef, peas and carrots, roast beef, milk, and rice from an Aug 5 meal contained no enteropathogenic organisms. Extensive questioning of the camp's maintenance staff and the investigators' personal examination of the plumbing systems disclosed no areas where contamination caused by cross connections or back-siphonage was likely to have occurred.

Laboratory Studies

The two fecal examinations for parasites and five stool specimens cultured for *Shigella*, *Salmonella*, and *Campylobacter* all demonstrated no pathogens.

Eight of nine paired blood specimens from staff who had been acutely ill showed a fourfold or greater increase in the antibody titer to Norwalk agent by radioimmunoassay (Table 2).

COMMENT

The symptoms and clinical course of the illness at the camp were compatible with gastroenteritis caused by a Norwalk-like agent. The high rate of seroconversion (8/9) confirmed the Norwalk virus as the causative agent.

Diarrhea occurred more frequently than vomiting in the staff (55% and 47%, respectively), but at a very low rate in the campers (9%). Part of this discrepancy could be explained by the different methods of obtaining data, using infirmary records for campers and questionnaires for staff. However, the observation that Norwalk virus produces diarrhea more frequently than vomiting in adults has been made in other outbreaks.[8]

The number of individuals (n=23) experiencing more than one episode of gastrointestinal tract illness raises questions about the possibility of relapses or reinfections. Short-term immunity to Norwalk agent has previously been reported.[1,8,12] Incomplete record keeping by the overworked infirmary staff may have led us to believe that campers had several symptom-free days between episodes. However, the rate of multiple episodes for staff members (6%), whose data were obtained from self-administered questionnaires, was not significantly different from the rate for campers (9%).

Although the source of the outbreak was never confirmed, several possibilities were considered. The epidemic curve was compatible with either a person-to-person spread or an intermittent common source. Environmental inspections and laboratory tests failed to disclose any signs of fecal contamination in either food or water; however, the outbreak may have been initiated by a contamination that was not present at the times these products were sampled. The outbreak could then have been perpetuated by secondary spread due to transmission via vomitus or fecal-oral routes that the close personal contact of camp life allowed for.

Pediatricians should be aware of the potential for large outbreaks when seeing patients with AING and educate patients and contacts on hygenic measures to reduce secondary transmission. Suspect outbreak situations should be immediately reported to public health officials. At the time of this writing, routine diagnostic tests were not available for Norwalk-like viruses and were not practical for sporadic cases.

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